

INTRODUCTION

"All the fertile areas of this planet have at least

once passed through the bodies of earthworms"

----Charles Darwin.

Earthworms are moisture loving creatures found only in moist places and where soil containing large amount of organic matter. They are very important components for the maintenance of soil fertility and nutrient cycling. Earthworms have long been described as the intestine of the earth, friends of farmers and nature's best fertilizers. In soil, the earthworms act as aerators, grinders, crushers, chemical degraders and biological stimulators. The utilization and importance of earthworms have been stressed by renowned scientists like Muller (1884), Darwin (1881).

Earthworms are the best known of all soil inhabiting animals which possess metamerically segmented, cylindrical body and are form half of the weight of soil animals. They are worldwide in distribution, excluding only the Arctic and Antartic regions. According to Lavlle *et al.*, (1997)

earthworms are identified as the most important soil ecosystem engineers in soils of the temperate regions of the world.

Now a days earthworms are used to prepare vermicompost, vermiwash etc, which are very useful for more yield of crop plants. In modern days the increase in production of food grains, crops and fodders is achieved by the application of modern science and technology such as crop husbandry methods involve the use of highly developed machinery and the application of inorganic fertilizers, organic pesticide chemicals, insecticides etc. These things are greatly affecting on population, growth, survival and breeding of the earthworms. Similarly the continuous use of chemical fertilizers and pesticides for more production of crop leads into soil salinity. In addition to this over irrigation is also responsible for soil salinity.

The characteristics of saline soil is that they contain sufficient neutral soluble salts like chlorides and sulphates of sodium, calcium, magnesium etc. According to Parthsarthy (1972), the saline soils are those in which salt content is high enough to impair crop productivity. Thus the saline soil contains toxic concentration of soluble salts in the root zone which adversely affect the growth of crop plants.

The survey of literature showed that along with large number of microbes, bacteria and other life forms which works together with the earthworms may play an important role in soil ecosystem. It is not known, up to what level the quality of saline soil is going to improve or whether the earthworms get suited themselves in such type of saline soil or not. Therefore the present study is undertaken to investigate the suitability of Earthworms species, *Eisenia foetida* to different samples of saline soil and by studying their behavior, growth and breeding.

1.1 Survey of Literature

The Survey of literature on growth, reproduction, cocoon production, breeding, feeding pattern etc. of earthworm with reference to pH, temperature, season, diet etc. which are cited hereafter. An in vitro study by Awaknavar and Karabhantanal (2004) has showed that the excessive use of pesticides like endosulfan, carbaryl and carbofuran for agriculture has threatened the survival and reproduction of earthworms.

The influence of environmental temperature on cocoon production, cocoon development and hatchling growth in case of *Eisenia foetida* was recorded by Neuhauser *et al.*, (1979), Reinecke and Kriel (1981) and

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Lofs-Holmin (1983). Further they have also showed that there is significant correlation between temperature and relative humidity with reference to cocoon production by Eisenia foetida. Similarly influence of temperature on hatching and growth of Eisenia foetida was studied by Tsukamoto and Watanabe (1977). The effect of environmental conditions on the growth and reproduction of the earthworm Eisenia andrei in an artificial soil substrate was studied by Van Gestel et al., (1992). The growth, reproduction and litter and soil consumption by Lumburicus terrestris L. in reclaimed peat was studied by Curry and Balger (1984). Similarly growth and reproduction of the compost living earthworms Eisenia andrei and Eisenia foetida was studied by Haimj (1990). Lofs-Holmi (1982) studied reproduction and growth of common arable land and pasture species of earthworms in laboratory culture. While the growth and cocoon production by Allolobophora rosea was studied by Phillipson and Bolton (1977).

Influence of soil temperature and moisture on the reproduction activity of tropical pasture earthworms of Orissa was studied by Senapati and Dash (1985).

The reproductive potential of the earthworm *Eisenia foetida* was studied by Harteinstein *et al*, (1979). According to Edwards (1998) the type, quality and quantity of the organic wastes were very important for determining the rates of growth of earthworms.

Nauhauser. et al., (1980) studied growth of earthworm Eisenia foetida in relation to population density and food rationing. The growth and cocoon production of the earthworm *Perionyx excavatus* was studied by Reinecke and Hallat (1989).

Development and fecundity of the manure worm, *Eisenia foetida* under laboratory conditions was studied by Tomlin and Miller (1980).

The reproduction and growth of the deep-burrowing earthworms in laboratory culture in order to assess production for soil restoration was studied by Butt (1993). Huhta and Haimi (1988). Studied reproduction and biomass of *Eisenia foetida* in domestic waste. The studies on the life cycle, growth and population dynamics of *Lampito mauriti* and *Eudrilus eugeniae* cultured in different organic wastes and analysis of nutrients and microbes of vermicompost was carried out by Ramalingam (1997). Viljoen and Reineeke (1988) studied the number, size and growth of hatchings of the African Night crawler, *Eudrilus eugeniae*.

They also studied the life cycle and reproduction of *Eudrilus eugeniae* under controlled conditions.

Influence of pH on the production of *Eisenia foetida* was studied by Rivero Fernandez (1991).

Reddy and Pasha (1993) studied effect of rainfall, temperature and some soil physico-chemical variables on seasonal population structure and vertical distribution of earthworms in two semi and tropical grassland soils.

The impact of organic material on biomass production and reproduction potential of commercial composting earthworm species: Eudrilus eugeniae, Perionyx excavates and Perionyx sansibaricus was studied by Suthar (2007).

Aire et al., (2002) has studied the density of earthworms and their effect on microbial biomass and activity in pig manure. Bostrom (1988) studied the effect of soil mixed with plant residues on growth and cocoon production of earthworm. Growth and reproduction in Eisenia foetida with the help of vermicomposting of cattle and goat manure was studied by Loh et al., (2005).

Similarly, Martin and Lavelle (1992)., Reinecke et al., (1990)., Rhee (1992)., and Suthar et al., (2005) studied effect of soil organic matter quality on growth and reproduction of the earthworm species Millosonia anomala, Eisenia foetida and Eisenia andrei respectively.

Fordsmad (2002) has studied the problem of saline soil in Australia. According to him large areas of the world, especially Australia and the Middle Eastern Countries, increasing soil salinity is the major problem in agricultural land. The salinity may either be due to naturally high levels of various salts or caused by poor irrigation practice.

The problem of Sodic soil has been studied by Ansari (2007). His investigation deals with the reclamation of sodic soil through the use of several organic amendments and highlights the role of earthworms in process of soil restoration.

The studies on growth and reproduction of earthworm *Eisenia* foetida in a defined medium was conducted by Bouwnam and Reinecke (1991).

The effect of clay content and acidity of soil on growth and reproduction of the epigeic earthworm species *Lumbricus rubellus* was studied by Klok *et al*., (2006).

A laboratory based investigation on cocoon production, morphology, hatching pattern and fecundity in seven tropical earthworm species namely *Perionyx excavates*, *Lampito mauritti, Polypheretima elongate*, *Pontoscolex corethrurus*, *Eutyphoeus gammiei*, *Dichogaster modiglianii* and *Drawida nepalensis* was conducted by Bhattacharjee and chaudhri (2002).

The studies on the sensitivity of a Japanese earthworm, Allolobophora japonica to soil acidity was conducted by Ohno (2001).

Growth and fecundity of earthworms *Perionyx excavatus* and *Perionyx sansibaricus* in Cattle waste solids was studied by Suthar (2007).

The role of earthworm in relation to soil fertility was studied by Syres and Springeet (1984). According to Pallaut and Hilster (1996) the addition of earthworms to acid mine spoils treated with sewage sludge

and lime might aid in the redevelopment of soil quality and biological diversity.

The earthworm effect on selected physical and chemical properties of soil aggregates was studied by Zhong and Schrader (1993). The influence of feeding patterns on growth and reproduction of the earthworm *Eisenia foetida* was studied by Reinecke and Viljoen (1990)

1.2 Analysis of the problem :--

The afore described critical survey of literature showed that much of the work is carried on the influence of temperature, season, moisture content of soil, pH, rainfall, feeding pattern etc. on the growth, reproduction, life cycle, cocoon production, food consumption etc. on the various species of earthworms. But it seems that there is scanty material on the effect of saline soil on growth, reproduction, life cycle, cocoon production etc. of the earthworm *Eisenia foetida*. In some part of Western Maharashtra our survey on soil salinity showed that especially in Sangli, Kolhapur, Satara and Ahmednager districts farmers are facing a great problem of saline soil. Over the years sugar factories in these areas have encouraged local farmers to concentrate on cultivation of sugarcane.

For more production of this crop, farmers started using excess water logging and chemical fertilizers which results into long-term salinity and damage to soil quality. Now a days, in various above mentioned parts, saline land has become a major problem for farmers.

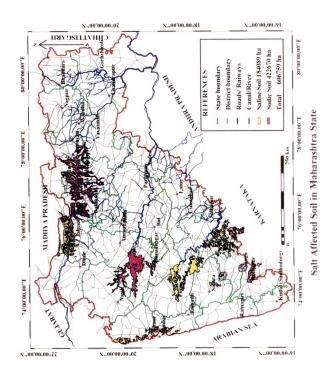
1.3 Selection of study area –

As mentioned above, the majority of low level lands of Miraj, Shirol and Walva Tahasil are becoming barren due to soil salinity. Such saline soil is becoming nonproductive but where the plants like *Parkinsonia aculata* and *Prosophis juliphera* grows vigorously which may be tolerate soil salinity.

Now a days Government of Maharashtra has under taken a scheme for reclamation of saline soil of this area. The photograph of the area selected for the present study is shown in plate No. 1 figs. 1 to 3.

According to survey of Department of Irrigation and Agriculture, about 42,530 hactare area of Kasabe Digraj region of Miraj Tahasil and 520.00 hactares area of village Shirati of shirol Tahasil have become

DIGITIZED MAP OF SALT AFFECTED SOILS OF MAHARASHTRA



MAP SHOWING STUDY AREA

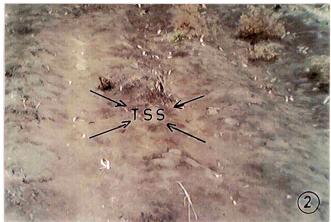
Plate No-1, Fig. 1 to 3

(Different study areas of Miraj Tahasil)

- Fig. 1. Study area showing Total saline soil, semi saline soil and normal soil of village Kasabe Digraj.
- Fig. 2. Study area showing total saline soil of village Kasabe Digraj.
- Fig. 3. Fig showing study area which is undertakes by the Govt. of Maharashtra for reclamation in village Kasabe Digraj.

PLATE NO.1







saline which directly affecting on production of food grains and crop plants.

As discussed earlier, the growth, reproduction, food consumption etc. are greatly affected by various environmental parameters such as soil humidity, temperature, organic matter, rainfall, season etc. These factors plays important role in various life processes which have been studied in great details. But, still there is vast scope for work on the important factors like the saline soil in relation to the growth and breeding in different species of earthworms.

At a comparative level, it is necessary to study influence of saline soil and normal soil on the growth and reproduction of earthworm. It is welknown that the reproduction of an animals takes place at controlled climatic conditions such as relative humidity, vapour pressure, rainfall, wind-velocity, day light etc. and also by various physical and chemical parameters in which they live. Thus the present investigation is analysed in relation to the physico-chemical parameters of the habitat that is the saline soil. The problem on the effect of saline soil on the growth and breeding of earthworm is being undertaken for the detailed analysis in our laboratory.

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1.4 Plan of research work :---

The present study is undertaken to investigate influence of saline soil on growth and breeding of terrestrial, annelid earthworm species *Eisenia foetida*. It involves following experimental procedures—

- 1] To select study area and to collect soil samples.
- 2] Collection of earthworms Eisenia foetida and proper stocking.
- 3] Analysis of physico-chemical parameters of substrate soil samples.
- 4] Preparation of sets such as A1, A2, B1, B2, C1, C2, D1 and D2 according to different substrate media (soil samples).
- 5] Acclimatization of earthworms at laboratory conditions and preparation of earthworm batches.
- 6] Introduction of earthworm batches in to respective sets A1, A2 to D2.
- 7] Proper maintenance of the worms and to record the behavioral changes, survival, growth, feeding, breeding etc.

8] To photograph the earthworm at different stages, their cocoons, young ones etc

The results of investigation are discussed in relation to the growth and breeding of earthworms in various substrate soil samples such as total saline soil, semi-saline soil, normal soil etc.

For the convenience of presentation and ease of understanding the next part of thesis is divided into three chapters. The second chapter deals with the materials used such as experimental animal, substrate soil samples, the various analytical methods such as analysis of standard and welknown physico-chemical parameters of substrate soil samples etc. Chapter third describes the observation on morphology, behavior, growth and breeding of the earthworm *Eisenia foetida*. Chapter fourth deals with the comparative aspects of growth and breeding of the worm *Eisenia foetida* in various substrate soil samples. This chapter also gives concluding remarks of the dissertation and certain ideas for further work with respect to growth and breeding in relation to saline soil.